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CENTRAL INTELLIGENCE AGENCY

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INFORMATION REPORT

COUNTRY USSR/Korea

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SUBJECT Chemical, Physical and Micro-examination of Russian HVAP hard carbide Penetrator

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SUPPLEMENT TO REPORT NO.

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1. The sample examined is described as follows:

   a. Identification of shell from which the penetrator was extracted: 88 mm HVAP, believed to have been manufactured in 1948.

   b. [redacted]

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   c. The size of the penetrator was 27.5 mm diameter x 90.0 mm long

   d. The ojive radius was 52 mm and the distance from the point to the beginning of the ojive was 33 mm.

2. Physical examination of the penetrator yielded the following information:

   a. Hardness - 71.5 Rockwell "c."

   b. Density - 14.40 Specific gravity.

   c. Transverse rupture load - 124,000 pounds per square inch.

   d. Axial marks along the penetrator at approximately 120° angular distance apart indicate that it was formed in a split mold.

      (1) The ojive was formed in pressing the specimen in a split mold.

      (2) The ojive had been "touched up" by a minimum of what appeared to be hand grinding.

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c. X-ray examination showed tungsten carbide and binder phases only.

f. The material was brittle and porous.

(1) The type of porosity suggests that the mix was dry ground.

g. Indications are that the specimen was sintered standing upright.

[On file in the CIA library is a photographic print illustrating the penetrator.]

3. Micro-examination at 1500 diameters revealed the following:

a. Coarse, somewhat porour structure was exhibited, indicating the use of secondary material as contrasted with the first-quality, lamp-filament tungsten required by U. S. specifications.

(1) There is evidence that a minor quantity of presintered, scrap, tungsten-carbide, tool material had been added to the mixture.

b. The structure also indicates a minimum of expensive and time-consuming powder grinding operations.

(1) Dry instead of wet grinding is indicated.

(a) This grinding process probably eliminates at least two and possibly three of the powder preparatory operations.

c. Binder mixing is also estimated as being poor in comparison with US quality techniques.

[On file in the CIA library is a photo-micrograph print illustrating the microstructure at 1500 diameters.]

4. Chemical analysis of the penetrator has yielded the following information concerning its composition:

Graphitic carbon	0.03 per cent
Carbon (C)	5.90 " "
Silicon (Si)	0.15 " "
Tungsten (W)	86.60 " "
Cobalt (Co)	0.58 " "
Titanium (Ti)	Trace
Tantalum (Ta)	0.09 per cent
Iron (Fe)	0.86 " "
Nickel (Ni)	3.25 " "
Chromium (Cr)	Trace
Molybdenum (Mo)	2.50 per cent
	99.96 per cent

a. In view of the constituents, Fe 0.86% and Cr (Trace), it appears that easily fabricated 18-8 alloy ball mills were employed in the preparation procedure instead of hard, carbide-lined ball-mills as are used in the USA, England and Germany.

b. The use of some presintered tool-material scrap is shown by the significant presence of tantalum (0.90% Ta) and possibly by the 2.50% Mo, although the presence of this quantity of molybdenum is not understood unless the Mo-W ores are ineffectively reduced.

c. The presence of cobalt (0.58% Co) may also indicate use of East-German, hard, carbide-tool-material scrap as a bulk additive to a secondary material.

d. The amount of nickel (3.25% Ni) is scant and might be taken as a measure to conserve a scarce metallic element. On the other hand, the small quantity of nickel may be deliberately intended to yield better performance in service.

(1) An increase in Ni would lower the specific gravity of the penetrator, already reduced by porosity resulting from cheap, fast, production techniques, thereby lowering the impact striking force for which the projectile is designed.

(2) Low binder content (Ni) would improve fragmentation after penetration had been accomplished.

5. The following conclusions are suggested by the reported analysis of only one specimen:

a. If the specimen were intended as a tool material, almost any qualified expert would report adversely on its character, composition, and microstructure and probably on the poor fabrication procedure employed.

(1) There is little doubt that the projectile would be rejected on the basis of its composition and structure by US ordnance inspectors. The composition and structure do not meet either USA or British specifications for similar projectile components.

b. It is nevertheless the opinion of the assessor that this penetrator has been very efficiently and economically made and is quite adequate for its expendable application.

(1) The essential metallurgical step of producing WC has been adequately performed. (Graphitic carbon is very low -- 0.03%. This is a criterion of quality for the metallurgical operation.)

(2) The transverse rupture strength of 124,000 psi, the hardness of 71.5 Rockwell "c", and the density of 14.40 SG are all believed adequate for the job.

c. The penetrator has been produced by methods which are neither characteristically German (hot pressed) or British-American (cold pressed and ground in the presintered condition).

(1) It is the opinion of the assessor that the specimen was produced by a well-calculated process in which well-grounded modification of German, British, and US practices are indicated.

(2) The specimen is believed to have been produced by intelligently planned, cheap, mass-production methods from inexpensive materials.

d. It is estimated that many thousands of similar penetrators could be quickly and inexpensively produced from secondary materials, by inexperienced labor, to perform adequately. Some of the savings in production time and cost indicated by this analysis are as follows:

(1) The penetrator is evidently cold pressed in split, mass-production molds to a conformation that does not require overall centerless grinding or grinding the ojive.

(2) The major portion of the specimen was in the condition in which it left the final (and probably only) sintering furnace operation.

(3) A general quality reduction to a level just good enough for the job, involving omission of time-consuming operations, is indicated by the micro-examination.

(4) Chemical analysis indicates a composition based on secondary materials instead of first quality, lamp-filament tungsten.

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